

# *Gulf Cooperation Council*

## 👉 EDICT OF GOVERNMENT 👈

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.

GSO 61 (1987) (English): INDUSTRIAL SAFETY AND  
HEALTH REGULATIONS INDUSTRIAL SAFETY AND HEALTH  
REGULATIONS HAZARDOUS MATERIALS – GASES PART 7:  
COMPRESSED AND LIQUEFIED NATURAL GAS



BLANK PAGE



هيئة التقييس لدول مجلس التعاون دول الخليج العربية  
STANDARDIZATION ORGANIZATION FOR G.C.C (GSO)



GSO 61/1987

اشتراطات السلامة والصحة الصناعية

المواد الخطرة – الغازات

الجزء السابع : الغاز الطبيعي المضغوط والمسال

**INDUSTRIAL SAFETY AND HEALTH REGULATIONS  
HAZARDOUS MATERIALS — GASES- PART 7:  
COMPRESSED AND LIQUEFIED NATURAL GAS**

**ICS:13.100**

# **INDUSTRIAL SAFETY AND HEALTH REGULATIONS HAZARDOUS MATERIALS — GASES- PART 7: COMPRESSED AND LIQUEFIED NATURAL GAS**

**Date of GSO Board of Directors Approval : 05-11-1407H (01-07-1987)**  
**Issuing status : Technical Regulation**

## CONTENTS

1.	SCOPE AND FIELD OF APPLICATION .....	2
2.	COMPLEMENTARY REFERENCES .....	2
3.	REGULATIONS.....	2
3.1	General Requirements.....	2
3.2	Containers Construction and Marking.....	3
3.3	Location of Containers and Regulating Equipment.....	3
3.4	Installation of Storage Containers.....	5
3.5	Piping, Tubing and Fittings.....	8
3.6	Container Valves.....	8
3.7	Vaporizers for Liquefied Natural Gas.....	10
3.8	Safety Relief Devices.....	10
3.9	Liquid Level Gauging Devices .....	11
3.10	Transfer of Liquefied Natural Gas .....	12
3.11	Warning Signs.....	13
3.12	Installation of Fuel Tanks of Cylinders for Motor Vehicles and Industrial Trucks .....	14

**INDUSTRIAL SAFETY AND HEALTH REGULATIONS**  
**HAZARDOUS MATERIALS — GASES PART 7:**  
**COMPRESSED AND LIQUEFIED NATURAL GAS**

**1. SCOPE AND FIELD OF APPLICATION**

This Standard is concerned with the industrial use of compressed and liquefied natural gas and other hydrocarbon gases except acetylene and liquefied petroleum gases.

**2. COMPLEMENTARY REFERENCES**

- 2.1 GSO 55/1987 “Industrial Safety and Health Regulations - Hazardous Materials - Gases - Part 1: General Requirements”.
- 2.2 GSO 208/1994 “Industrial Safety and Health Regulations - BuildingGSO Part 3: Fire Protection”.
- 2.3 GSO 60/1987 “Industrial Safety and Health Regulations - Hazardous Materials Gases - Part 6: Liquefied Petroleum Gases”.
- 2.4 GSO 208/1994 “Industrial Safety and Health Regulations - Electrical Part 2: Low Voltage”.

**3. REGULATIONS**

**3.1 General Requirements**

**3.1.1 Odourizing**

No gas shall be delivered into any vessel or system covered by this standard unless odourized. The gas shall have a distinctive odour of sufficient intensity so that the presence of the gas may be detected down to the concentration in air of not over 1/15 the lower limit of flammability. Odourants in the concentrations used shall be:

- Harmless to humans.
- Non-toxic.
- Non-corrosive to materials used.
- Non-soluble in water to an extent greater than 2.5 parts by weight of odourant to 100 parts by weight of water.
- Compatible with gas at the pressures and temperatures to be encountered in storage, transfer, and service.

Note: Odourization is not required if harmful in the use of further process of the liquefied gas, or if odourization will serve no useful purpose as a warning agent in such use.

**3.1.2 Approval of Devices**

3.1.2.1 All devices which are used in gas installations shall be of a type and construction suitable for their intended use. The authority shall approve or accept devices or package units upon satisfactory evidence that they are designed and constructed for safe operation in gas service.

3.1.2.2 Except for control and indicating devices that are also designed for gas and which have an orifice not larger than 1.5 mm diameter size, gas shall not be used to operate any device or equipment designed to be operated with compressed air which exhausts to the atmosphere.

Gas vapour shall not be released into the air except as permitted by this item.

3.1.2.3 All gas devices not otherwise specifically provided for, shall be constructed and installed to provide safety equivalent to that required for other parts of the system.

**3.2 Containers Construction and Marking**

All gas containers shall be designed, constructed, marked, and tested according to the Gulf Standard mentioned in item 2.1 with the following special consideration:

3.2.1 The outer vessel of the double wall cryogenic vessel shall be designed for full range of pressure and/or vacuum to which it will be subjected and for additional structural support of the inner tank and insulation under all imposed loading.

3.2.2 The jacket shall be equipped with device to release internal pressure. The area of discharge shall be 0.0034 sq.cm/kg of water capacity of inner tank but the area needs not exceed 2000 sq.cm. The device must function at a pressure not exceeding the internal design pressure of the jacket, external pressure on inner tank, or 173 kPa, whichever is less.

**3.3 Location of Containers and Regulating Equipment**

The location of containers shall comply with the Gulf Standard mentioned in item 2.1 and as follows:

**3.3.1 General**

3.3.1.1 Except as provided elsewhere in this item, tanks, cylinders, and regulating equipment used with gas storage and/or dispensing installations shall be located outside of buildings. Each individual tank or cylinder used for storage or for dispensing gases, shall be located with respect to the nearest building or source of ignition, in accordance with Table 1.

**Table 1**  
**Location of Tank or Cylinder**

Water capacity per Container (litres)	Minimum Distances	
	From container to property line	Between adjacent containers
Less than 500	None	None
501 to 100	3 M	None
1001 to 2000	2 m	1 m
2001 to 7500	7.5	1 m
7501 to 100,000	15 m	1.5 m
100,001 to 270,000	23 m	$\frac{1}{4}$ sum of diameters
Above 270,000	0.7 times the container diameter but not less than 30.5 m	of adjacent container, but not less than 1.5 m.

Note: At the discretion of the authority, tanks may be located at a lesser distance from important buildings constructed of concrete or masonry materials.

- 3.3.2 No stationary storage vessel shall be located less than 3 m from the nearest street line or sidewalk, nor less than 15 m from the nearest rail of any railroad main track. The distance between underground tanks shall be not less than 3 m.
- 3.3.3 Except as permitted in item 3.11.3, filling connections shall not be located less than 3 m from any opening into or under a building closed on more than 3 sides for filling connections 12 mm pipe size or less than 4.5 m for larger sized filling connections.
- 3.3.4 Readily ignitable material shall not be permitted within 3 m of any stationary vessel or vaporizer.
- 3.3.5 Regulators which are vented to atmosphere shall be installed in such a manner that moisture cannot enter the vent and accumulate above the diaphragm. Where the regulator vent may be obstructed due to rain, shields, hoods, or other suitable devices shall be provided to guard against closing the vent opening.
- 3.3.6 Compressed Gas
- 3.3.6.1 Multiple cylinder units or groups stored in the vertical position shall be limited to a width of no more than 4 cylinders. Units or groups stored in the horizontal position shall be limited to a height of 6 and a width of 4 cylinders. When stacked horizontally, the units or groups shall be separated by not less than 1 m.
- 3.3.6.2 No cylinder filling platform shall be located less than 3 m from any storage tank, or 4.5 m from the nearest important building or line of adjoining property. At the discretion of the authority, cylinder filling platforms may be located at a lesser distance from important buildings constructed of concrete or masonry materials.



- 3.3.7 Liquefied Natural Gas
  - 3.3.7.1 All above ground LNG tanks larger than 7500 litres shall have diked impounding areas or equivalent.
- 3.4 Installation of Storage Containers
  - 3.4.1 Aboveground Containers
    - 3.4.1.1 Storage tanks installed aboveground shall be installed on firm masonry or concrete foundations. Aboveground horizontal tanks shall have no more than 2 points of support longitudinally- Where necessary, tanks shall be securely anchored to prevent floating.
    - 3.4.1.2 metallic structural supports, when used, shall be encased in concrete or other material having a fire resistant rating of at least 2 hours when the distance between the lower surface of the tank and the top of the concrete or masonry foundations exceeds 0.5 m. In the case of a vertical tank having no more than one opening in the support skirt, the interior fire protection of the skirt may be omitted.
    - 3.4.1.3 Every tank shall be so supported as to prevent the concentration of excessive loads on the tank at the points of support. All foundations and fastenings shall be designed to provide reasonable safety under all imposed loads including wind, earthquake, vibrations, etc. All tanks over 4500 litres capacity shall be installed on foundations in such a manner as to permit expansion and contraction.
    - 3.4.1.4 The valves and other appurtenances on tanks at all bulk plants, if the plant is not otherwise fenced, shall be surrounded by a rugged steel fence or equivalent. Fences which are not of an open mesh type may be used provided that they are acceptable to the local fire brigade. The fence required shall be at least 1.8 m in height. Any fence completely surrounding the tank shall be located at a minimum distance of 1 m from the tank. Other tanks shall also be surrounded by a rugged steel fence or equivalent, if in the opinion of the authority a fence is needed to prevent unauthorized tampering. All fenced areas shall be kept locked when unattended.
    - 3.4.1.5 Aboveground storage tanks shall be protected from impact from trucks, trailers, and other vehicles, where such impact is likely or probable, by suitable curbs, fences or posts and railings. Such curbs or fences shall be arranged so that they will not hamper free ventilation around the tanks.
    - 3.4.1.6 All loading and unloading connections at bulk plants shall be secured to a concrete bulkhead or equivalent designed to withstand the load imposed by the strongest pipe, hose or flexible metal hose, and fittings to be used in the transfer operation without breaking or 810 kg whichever is greater unless other protection is provided. This bulkhead shall not be located underneath the tank. The loading and unloading connections shall be firmly secured to this bulkhead and the line between the bulkhead and tank shall be installed in a manner to provide for expansion, contraction, jarring, vibration, and settling. Such bulkhead shall be located not less than 7.5 m from the nearest building or line of adjoining property. When in the opinion of the authority such bulkhead is necessary for the safety of the place of employment, it shall be required at storage plants other than bulk plants mentioned above.

- 3.4.1.7 The fill line on storage tanks shall be equipped with a back-flow check valve to prevent discharge of the natural gas from the receiving tank in case of line, hose or fittings rupture.
- 3.4.1.8 A fire extinguisher conforming to the provision of the Gulf Standard mentioned in item 2.2 and having a B rating shall be available and ready for use during the time the gas is being transferred. The extinguisher carried on a bulk delivery or transportation vehicle may be considered as meeting the requirement of this item when transferring gas from or to such vehicle provided the extinguisher has the required rating listed above.
- 3.4.1.9 Compressed Natural Gas
- 3.4.1.9.1 When the tank is installed directly on concrete or masonry foundations, a corrosion pad shall be provided at the points of contact with the foundation. These corrosion pads shall be at least 5 mm thick, and shall be of a width at least equal to that of the foundation at the point of contact with the tank, but in no case shall they be less than 8 times the shell thickness in width. When corrosion pads or pad-type steel supports are used, the pads shall have corners rounded to a radius of not less than 6 times the pad thickness, and shall be attached to the shell with a continuous seal weld. These pads shall be not less than 1/4 the circumference of the shell in length.
- 3.4.1.9.2 Pressure vessels which are made of materials that are subject to corrosion by atmospheric conditions and which are not provided with an allowance for external corrosion by a suitable increase in the design thickness shall be protected by painting or other equivalent means necessary to check active corrosion.
- 3.4.1.9.3 Cylinders used at dispensing stations shall be installed on firm concrete or masonry foundations and located in accordance with items 3.3.1 and 3.3.2.
- 3.4.1.10 Liquefied Natural Gas
- 3.4.1.10.1 Supports for LNG tanks shall be designed to withstand low temperature effects of LNG spillage.
- 3.4.1.10.2 LNG tanks installed in a battery shall be so installed that the 90 percent outage levels or the top surfaces of the tanks are substantially in the same horizontal plane.
- 3.4.1.10.3 Tanks installed in a battery shall not be installed with liquid and/or vapour lines connecting into common headers unless either:
- The working pressure of all such tanks is the same, or
  - Check valves or other devices are installed in the system to prohibit the introduction of the higher pressure product into the lower pressure tank.
- 3.4.2 Underground Tanks
- 3.4.2.1 Tanks and regulating equipment shall not be buried below ground unless written permission to do so has been obtained from the local fire brigade and the following special conditions are complied with:
- 3.4.2.1.1 The proposed location complies with item 3.3. 1.

- 3.4.2.1.2 The tank shall be set with the top at least 60 cm below the surface of the ground, shall rest on firm foundations and shall not be installed under roadways.
- 3.4.2.1.3 Before any backfilling is done, the installation shall be inspected by local fire brigade and shall comply with all applicable items in this standard.
- 3.4.2.1.4 The backfilling shall be done in such a manner that there will be at least 15 cm of waterwashed sand free from soil, rocks or gravel immediately adjacent to the tank. The sand shall be well tamped into place during the backfilling operation.
- 3.4.2.1.5 All buried tanks shall be constructed for underground service and the manufacturer shall provide means for lowering the tank into place without any damage to the tank and to the applied corrosion-resistant coating.
- 3.4.2.1.6 If the valves and fittings are located in a curb box, an adequate provision shall be provided for proper drainage and ventilation of the curb box.
- 3.4.2.1.7 No curb box shall be larger than necessary for the operation and maintenance of the valves and fittings located therein nor more than 1 m in depth.
- 3.4.2.1.8 All buried tanks shall be completely uncovered for inspection of all external surfaces at intervals of at least once every 3 years. The intervals may be changed at the discretion of the local fire brigade if a test plate is buried adjacent to the tank and shows no appreciable corrosion on inspection after 3 years of service; provided, however, that every tank shall be uncovered at least every 15 years. The test plates shall be of the same material as the shell of the tank and shall be at least 1/4 of the tank diameter in length and 150 mm wide and shall be buried in water-washed sand at least as deep as the lowest surface of the tank, and shall not be coated. The plates, shall be provided in accordance with the following:
- Tanks 3 m or less in length, 1 test plate.
  - Tanks more than 3 m but less than 6.1 m in length, 2 test plates, 1 on each side near opposite ends.
  - Tanks 6.1 m or more in length, 1 test plate for each 3 m of length, placed on alternate sides at 3 m intervals.
- 3.4.2.1.9 No tank used underground shall be reinstalled aboveground until it has been inspected and found to be in compliance with the requirements for an aboveground installation.
- 3.4.2.1.10 Where necessary, tanks shall be securely anchored or weighted to prevent floating.
- 3.4.2.1.11 Compressed Gas The exterior tank surfaces shall be covered with corrosion-resistant material.
- 3.4.2.1.12 Liquefied Natural Gas LNG vessels utilizing a vacuum jacket shall be so installed that a vacuum leak can be detected, and so piped that means can be provided to restore the vacuum or minimize the leak.
- Consideration shall be given to the design and installation of the supporting members and surrounding materials in the possible freezing zone to prevent damage to the tank and its supports by low temperature effects of LNG spillage or by frost-heaving.

- LNG vessels having an outer jacket made of a material which may be subject to corrosion shall be protected in accordance with item 3.4.2.1.11,

### 3.4.3 Skid Tanks

Skid tanks shall be securely fastened to skids extending the full length of the tank, including fittings and guards at the end of the tank. The bottom of the skids shall be not less than 5 cm nor more than 30 cm below the outside bottom of the tank shell. The skids or lugs for attachment of the skids shall be secured to tanks in accordance with the rules under which the tank is designed and built, and shall be designed to withstand the loaded weight of the tank in any direction with a factor of safety of at least 8.

3.4.3.1 Fittings on skid tanks shall be installed in a recessed well or otherwise protected by means of guards.

3.4.3.2 Unless installed in compliance with item 3.4tl, skid tanks shall not be used at any location for more than 180 days without written permission from the local fire brigade.

3.4.3.3 When skid tanks are transported from one location to another, they shall be secured to the transporting vehicle.

3.4.4 Installation of Tanks on Transportation and Bulk Delivery Vehicles  
Transportation tanks shall comply with the regulations for such vehicles approved by GCC.

### 3.5 Piping, Tubing and Fittings

Provisions of the Gulf Standard mentioned in item 2.1 shall apply, except as noted below.

#### 3.5.1 General

3.5.1.1 Underground piping shall be at least 0.5 m below ground. It shall be coated with zinc or other corrosion resistant material.

3.5.1.2 The use of cast iron or malleable iron for any component is not permitted.

3.5.1.3 Plastic pipes, tubing hose, and fittings shall not be used.

3.5.1.4 Copper alloy with copper content exceeding 70 percent shall not be used.

#### 3.5.2 Compressed Natural Gas

Hose shall not be used in lieu of manifolds, piping, or tubing between container and loading or unloading hose connections. However, metallic hose not exceeding 60 cm in length may be used for flexibility.

#### 3.5.3 Liquefied Natural Gas

3.5.3.1 Flanged joints and threaded joints shall be kept to a minimum. When used for low temperature, threaded joints shall be sealed or seal welded. Welded joints are preferred.

3.5.3.2 Compression type couplings shall be avoided.

### 3.6 Container Valves

- 3.6.1 Compressed Natural Gas
- 3.6.1.1 Except for safety relief valves and gauging connections all vessel connections other than those in motor fuel tanks or cylinders, larger than 6 mm pipe size shall have one of the following installed directly in each connection:
- A back flow check valve to prevent flow from the tank
  - An excess - flow valve.
- 3.6.1.2 A manually operated shutoff valve shall be installed as close to the vessel as practicable.
- 3.6.1.3 Piping systems shall be protected against overpressure by safety relief devices. Relief devices installed to protect the piping system shall have sufficient capacity and shall be set to open at a pressure not exceeding 110 percent of the maximum allowable working pressure of the system or the pressure which produces a hoop stress of 75 percent of the specified minimum yield strength, whichever is lower.
- 3.6.2 Liquefied Natural Gas
- 3.6.2.1 LNG, flammable refrigerant, flammable liquid, and flammable gas container connections larger than 25 mm in size and through which liquid can escape shall be escape.
- A valve which closes automatically in the event of fire.
  - A remotely controlled, quick-closing valve which shall remain closed except during the operating period.
  - A check valve on filling connections.
- 3.6.2.2 Extended bonnet valves shall not be installed with a stem positioned below the horizontal.
- 3.6.2.3 Shutoff valves shall be provided on all LNG container connections except those for relief or gauging devices and those that are plugged or blanked. Shutoff valves shall be located as close as practicable to such containers.
- 3.6.2.4 In the design of piping system, consideration shall be given to the installation of shutoff or block valves as means of limiting volume of LNG that could be discharged in the event of piping failure. The following valves shall be provided.
- Sufficient valves, which can be operated both from installed location and remote locations for shutting down the process.
  - Provisions of item 3.6.2. 1.
- 3.6.3 Container Valve Protection
- Container valve protection shall be provided in accordance with the Gulf Standard mentioned in item 2. 1.
- 3.6.4 Hose Connections Provision of the Gulf Standard mentioned in item 2.3 shall apply except;
- Material shall be suitable for gas.

- Burst pressure design shall be 4 times the maximum working pressure.
- Test pressure shall be 2 times the working pressure.
- 3.7 Vaporizers for Liquefied Natural Gas
  - 3.7.1 Design, construction, and testing of vaporizers shall be based on good engineering practice.
  - 3.7.2 Vaporizers in excess of 4 litres capacity shall be provided with suitable automatic means to prevent liquid from passing into the vapour system. This is not applicable to vaporizers discharging back to the vessel only.
  - 3.7.3 Vaporizers in excess of the 4 litres capacity shall be provided with 1 or more safety relief valves suitable for use with the natural gas and set to open at not less than the maximum working pressure and not more than 10 percent of the maximum working pressure of the vaporizer.
  - 3.7.4 The minimum relieving capacity of the safety relief valves shall be at least equal to the capacity marking on the vaporizer nameplate. This marking shall be determined for exposure to external fire and shall be sufficient to prevent pressure in the vaporizer from exceeding 120 percent of the maximum working pressure.
  - 3.7.5 The safety relief valve discharge shall be led outside of the vaporizer building, if any, and be discharged at a safe place.
  - 3.7.6 No coil or other device carrying artificial heat for vaporization shall be located inside any LNG vessel not constructed for vaporizing only.
  - 3.7.7 Vaporizers shall not be installed inside a buildings unless they are specifically designed for housing LNG vaporizers; in which case the building shall be constructed of non-combustible material and be adequately ventilated at both the floor line and ceiling. Ventilation shall be designed to prevent gases lighter than air from being trapped at ceiling level.
  - 3.7.8 Surge tanks, containing vapour only at 137,26 kPa cm or less, shall be located at least 3 m from buildings and property lines. Such tanks operating at pressure exceeding 137,26 kPa shall be located with respect to buildings and property lines in accordance with item 3.3. 1, and Table 1.
- 3.8 Safety Relief Devices
  - 3.8.1 General consideration of the Gulf Standard mentioned in item 2.1 shall apply except as noted in the following items:
    - 3.8.1.1 Safety relief valves for gas service shall not be fitted with lifting devices. The adjustment, if external, shall be provided with a means for sealing the adjustment to prevent tampering. Only competent and technically trained personnel shall repair, adjust, or test such devices.
    - 3.8.1.2 Fusible plugs and/or rupture discs are prohibited for primary relief devices.
  - 3.8.2 Compressed Gas
    - 3.8.2.1 The minimum required rate of discharge of the safety relief valves for aboveground tanks shall be at least equal to any input from the system, whether stored or being compressed.

- 3.8.2.2 Safety relief valves located on stationary tanks of over 4700 cu.m of gas at standard conditions, shall be fitted with ferrous standpipes which will discharge at least 61 cm above the top of the tank, but not less than 3 m above ground level. These standpipes shall not be threaded at the open end, and shall be fitted with suitable drain openings. Return bends and pipe fittings at the upper ends of safety relief valve discharge pipes are prohibited. Standpipes shall be adequately braced or otherwise supported if over 1.2 m in length.
- 3.8.2.3 Safety relief valves for underground tanks shall have a relieving capacity of not less than that required for aboveground tanks.
- 3.8.3 Liquefied Natural Gas
- 3.8.3.1 The minimum relieving capacity of the safety relief valves for LNG tanks shall be at least equal to the capacity marking on the vessel nameplate.
- 3.8.3.2 Safety relief capacity shall be determined for exposure to external fire and shall be sufficient to prevent pressure in the tank from exceeding 120 percent of the allowable working pressure for tanks built with a factor of safety of less than 5 and 150 percent for tanks built with a factor of safety of 5 or more.
- 3.8.3.3 Safety relief valves for underground LNG tanks shall have a relieving capacity at least equal to the relief valve capacity markings on the vessel nameplate. When the capacity is not based on exposure of the vessel to fire, such underground tanks shall not be uncovered until they are free of liquid.
- 3.8.3.4 Safety relief valves located on stationary tanks over 7500 litres capacity shall be fitted with ferrous standpipes which will discharge at least 60 cm above the top of the tank but not less than 3 m above ground level. These standpipes shall not be threaded at the open end, and shall be fitted with suitable raincaps and shall be provided with a drain opening at their lower end unless the safety relief valves discharging into the standpipes are fitted with suitable drain openings. Return bends and pipe fittings at the upper ends of safety relief valve discharge pipes shall be prohibited. Standpipes shall be adequately braced or otherwise supported if over 1.2 m in length.
- 3.8.3.5 The outer tanks of LNG vessels shall be provided with one or more relief devices set to open at not more than the maximum design working pressure of the outer tank. The discharge area shall be not less than 0.0034 sq.cm/kg of water capacity of the inner tank.
- 3.9 Liquid Level Gauging Devices
- 3.9.1 A permanent dip pipe shall be installed in all LNG tanks filled by volume and shall be of such length that it will indicate when the tank is filled to the level specified by the manufacturer and in no case more than 90 percent. This fixed dip pipe shall be permanently installed in the tank. Additional dip pipes may be used provided that they are permanently marked to show the outage they indicate.
- 3.9.2 In addition to the fixed dip pipe required in item 3.9.1 above, each LNG tank 225 litres capacity or more, filled by volume, and each motor fuel tank shall be equipped with a liquid level gauge.

- 3.9.3 Gauging devices that require bleeding of the product to the atmosphere shall be so designed that the maximum opening of the bleeder valve is 1.5 mm diameter.
- 3.9.4 Gauging devices shall be designed for the most severe pressure and temperature conditions to which the device may be subjected with a factor of safety of not less than 4. Such gauging devices shall be labelled with the maximum permitted pressure by the manufacturer.
- 3.9.5 Where the efficiency of the insulation of an insulated tank is dependent upon the vacuum in an annular space, an indicating device or other means shall be provided to warn of loss vacuum.
- 3.10 Transfer of Liquefied Natural Gas
- 3.10.1 General
- 3.10.1.1 No gas shall be vented to the atmosphere unless the vent is led to a safe point of discharge. Nothing in this item shall prohibit the use of gauging devices which vent to the atmosphere through an opening not exceeding 1.5 mm diameter.
- 3.10.1.2 No smoking or open flame shall be permitted within 3 m of any vessel during the filling operation.
- 3.10.1.3 All threaded filling connections shall be kept effectively capped when not in use. These caps or plugs shall be so designed that they will vent to the atmosphere while at least 3 full threads are engaged.
- 3.10.1.4 No employer or employee shall charge gas into any tank or cylinder not specifically designed for the most severe pressure and temperature conditions to which the vessel may be subjected.
- 3.10.1.5 During the transfer of gas at least one attendant familiar with the transfer operation shall be responsible for and be on the premises during the transfer operation. During the transfer of LNG the attendant shall remain in attendance at the controls necessary to stop the transfer operation. The attendant required by this item may be considered familiar with the transfer operation after he has been provided with a set of instructions for the transfer operation and has performed the operation at least through 3 full cycles under supervision. When gas is being transferred to or from a motor vehicle, the engine shall be stopped unless the motor is used to operate a pump or compressor required to transfer the product. During such loading or unloading from transportation tanks, the hand or emergency brake of the vehicle shall be set and the wheels blocked. Transportation tanks shall be electrically bonded during the transfer operation except that bonding is not required where the transfer system are depressurized by bleeding before disconnecting, and providing also that closed connections are made before transfer begins.
- 3.10.1.6 No gas shall be transferred with the point of delivery less than 3 m from any building or other facility, or within 1.5 m from a sidewalk a public highway, a street, or a road unless the failure to transfer would create a hazard. Nothing in this item shall be so construed as to prohibit the following:
- The fueling of machinery or vehicles used in road construction or maintenance.



- The filling of motor fuel tanks or cylinders of not more than 120 litre capacity.
- 3.10.1.7 Pumps and compressors shall be suitable for use with the product to be handled for the full range of pressure and temperature. Positive displacement transfer pumps shall be equipped with a pressure actuated bypass valve and/or a recirculating system which shall limit the pressure to the maximum design pressure of the pump or piping system whichever is lower.
- 3.10.1.8 Control devices shall be designed for the pressure, temperature, and service expected and shall be so installed that icing conditions will not cause malfunction.
- 3.10.1.9 The owner and/or user shall maintain all pressure vessels and their appurtenances, piping systems, vaporizers, controls, and devices in safe condition.
- 3.10.1.10 A portable fire extinguisher having a B-C rating shall be provided at the transfer operation area.
- 3.10.2 Compressed Natural Gas
  - 3.10.2.1 The pressure to which a tank is charged shall not exceed the maximum allowable working pressure of the tank being filled at normal temperature.
- 3.10.3 Liquefied Natural Gas
  - 3.10.3.1 To provide for the expansion of LNG with temperature, the tanks shall not be filled beyond the level specified by the tank manufacturer and in no case more than 90 percent of total capacity.
  - 3.10.3.2 Tank fuel loading and unloading areas shall be substantially level.
- 3.10.4 Tank car or transport truck loading or unloading point and operations shall comply with the Gulf Standard mentioned in item 2. 1.
- 3.10.5 Electrical equipment and other sources of ignition shall comply with the Gulf Standard mentioned in item 2.1 and as follows:
 

Electrical equipment installed out doors for stationary storage or the transfer of gas shall suitable for use in Class 1, Group D, Division 1, hazardous location when installed within 3 m in any direction of any connection used for transfer of gas. (Refer to the Gulf Standard mentioned in item 2.4).
- 3.11 Warning Signs
  - 3.11.1 All tanks and cylinders in excess of 225 litres capacity, except transportation tanks and fuel tanks on motor vehicles, shall have the word “FLAMMABLE” painted or otherwise suitably applied on each side that is readily visible.
  - 3.11.2 Warning signs with the words “NO SMOKING OR OPEN FLAMES PERMITTED WITHIN – METRES” shall be paintend or otherwise suitably applied on each stationary tank or on a sign posted adjacent to the tank. This sign shall also be posted adjacent to all loading and unloading terminals and vaporizers located not more than 15 m from the tank.

Note: The distance shall be that shown in the following table:

Table 2

Volumetric Capacity of Tanks and Cylinders in Litres	Minimum Distance From Open Flame in Metres
225 to 2000 inclusive	3
2001 to 7500 inclusive	7.5
Over 7500	15

When 2 or more tanks are installed in a battery, the requirements of items 3.1 1.1 and .2 will be considered as being complied with when the required warning signs are prominently displayed on all exposed sides of tanks.

- 3.11.3 Storage, Transfer and/or Vaporization of Gas Within Buildings for the Purpose of Filling Motor Fuel Tanks or for Operating Stationary Internal Combustion Engines
- 3.11.3.1 Gas and LNG may be stored or vaporized within a building or an enclosure providing that the structure is of non-combustible construction, it is used for industrial purposes only, and the floor area does not exceed 50 sq.m.
- 3.11.3.2 The space shall be used exclusively for the vaporization of LNG or for the storage of not more than a total of 1175 standard cu.m of gas or 1900 litres of LNG. If vapours heavier than air can be present, the structure shall not be below ground level and the space below the floor shall either be of solid fill or else properly ventilated to the open air.
- 3.11.3.3 In all cases adequate ventilation must be provided at both floor and ceiling levels. The requirements of this item may be met by either:
- A continuously operating mechanical ventilation system.
  - A gravity ventilation system composed of a combination of wall vents at the floor level and roof ventilators, or a combination of the two.
- 3.11.3.4 Pumps and compressors should be located outdoors in a freely ventilated area. If installed within a building, such a building shall be open on at least one side or be of louvered construction on at least two sides unless other acceptable ventilation is provided and it shall also be equipped with adequate roof ventilators.
- 3.11.3.5 All electrical wiring and electrical equipment shall be suitable for use in Class 1, Group D, Division 1 location if gas is transferred within a building or enclosure. All other electrical wiring and electrical equipment located within a building where there is no transfer shall be suitable for use in a Class 1, Group D, Division 2, hazardous location. (See the Gulf Standard mentioned in item 2.4).
- 3.11.3.6 All gas piping to the building shall be provided with shutoff valves located outside the building.
- 3.12 Installation of Fuel Tanks or Cylinders for Motor Vehicles and Industrial Trucks
- 3.12.1 Motor fuel tanks or cylinders shall be located in a place and in a manner to minimize the possibility of a physical damage.

- 3.12.2 Motor fuel tanks or cylinders for passenger type vehicles may be located in the trunk compartment provided the trunk compartment is properly ventilated and the safety relief valve discharge is piped outside. When a motor fuel tank or cylinder is installed inside a trunk or other compartment, positive means shall be provided to prevent leakage of a natural gas into the passenger or driver's compartment. Vehicle tanks or cylinders that have their connections or appurtenances in the end shall have as much space as possible for connecting the required flexible metal hose or tubing and for operating the manually operated shutoff valve.
- 3.12.3 If radio transmitting or receiving equipment is located in the same compartment as the fuel tank or cylinder, such transmitting or receiving equipment shall be enclosed in a vapour-tight compartment or otherwise protected from escaping fuel, unless the radio equipment is approved for use in a Class 1, Group D, Division 1 location. (See the Gulf Standard mentioned in item 2.4).
- 3.12.4 For passenger-carrying or other commercial vehicles, motor fuel tanks or cylinders and their valves and appurtenances may be installed in a recess which is vapour-tight to the inside of the vehicle and accessible from and vented to the outside.
- 3.12.5 Valves, fittings, and appurtenances containing gas shall not be located in the passenger or driver compartment unless all such valves, fittings, and appurtenances are positively sealed off from and vented to a point outside the passenger or driver compartment.
- 3.12.6 Each motor fuel tank shall be provided with a manually operated shutoff valve screwed directly into the tank connection. The manual shutoff valve shall be readily accessible or shall be an electrically operated valve installed in the line next to the manual valve. The manual shutoff valve shall be legibly labeled "Shutoff Valve". In installations of multiple cylinder manifolding, there shall also be a master shutoff valve either electrically or manually operated and located downstream from, but as close as possible to, the last cylinder in the series. In these cases there shall be a label indicating "Shutoff Valve" at the master valve and the individual tank valves need not be labeled.
- 3.12.7 Motor fuel tanks or cylinders shall be installed in such a manner that the bottom of the vessel and/or any connection thereto shall not be lower than the lowest horizontal axle when the vehicle is fully loaded.
- 3.12.8 Vents from control devices shall discharge outside the trunk compartment or other confined space.
- 3.12.9 Motor fuel tanks or cylinders shall be secured in a manner to prevent jarring loose, slipping or rotating of the tanks. Such fastening shall be designed to withstand loadings in any direction equal to the filled weight of the tank with a factor of safety of at least 8. Motor fuel tanks or cylinders shall not be fastened directly to the gasoline fuel tank. Compensation shall be made for the added weight by proper design or redesign of the vehicle suspension system when the loaded weight of the vehicle exceeds the manufacturer's maximum specifications.
- 3.12.10 Manifolded motor fuel tanks or cylinders shall be supported and held together as a unit by structurally adequate means. Manifolded branch lines shall be sufficiently flexible to prevent damage to the lines, valves, and tanks due to vibration, expansion or contraction. Valves and appurtenances shall be protected from

- mechanical damage either by being located in recessed wells or by adequate guarding.
- 3.12.11 All connecting parts of the fuel system shall be installed in such a manner as to prevent abrasion, vibration, or fatigue and physical damage.
- 3.12.12 Field welding, where necessary, shall be made only on saddle plates, brackets, or other nonpressure parts that were provided and installed by the manufacturer of the tank or cylinder. There shall be no welding on the vessel shell or heads other than that by GCC authorized personnel.
- 3.12.13 The connection between the motor fuel tanks or cylinders and the reducing valves, vaporizer, or other devices used to reduce the pressure to that needed for carburation shall be of flexible metallic tubing, wire-braided hose or equivalent with a factor of safety of not less than 5 for the most severe pressure and temperature design conditions. There shall be as few connections and fittings as practicable.
- 3.12.14 Automatic pressure reducing equipment shall be used for the purpose of reducing the pressure of gas to the carburetor, which shall not exceed 34 kPa. Positive means shall be provided to prevent malfunction due to refrigeration effects. There shall be a device in the fuel supply system which will automatically stop the flow of fuel when the engine is not running.
- 3.12.15 Each driver shall be trained in the safe use of this fuel system and be provided with a set of operating instructions. While the gas motor fuel tank or cylinder is being filled, the vehicle parking or emergency brakes shall be set and the motor shutoff. All transfer operations shall be supervised by an attendant familiar with the transfer operation. The attendant may be considered familiar with the transfer operation after he has been provided with a set of instructions and has performed the transfer operation at least through 3 full cycles under supervision. Where LNG motor fuel tanks or cylinders are being filled, the attendant shall remain at the controls necessary to stop the transfer operation.
- 3.12.16 Fill connections for motor fuel tanks or cylinders shall have at least one back-flow check valve or device. Quick disconnect couplings may be used provided they are designed for the most severe pressure and temperature conditions with a factor of safety of at least 5 and provided they are leak-tight in the connected and disconnected shutoff conditions. These couplings shall not be used in lieu of any required manually operated shutoff valves.
- 3.12.17 When motor vehicles are to be parked within buildings, provisions shall be made such as roof ventilation to prevent gases lighter than air from being trapped at ceiling levels. No source of ignition, electrical or otherwise, shall be permitted at those levels.